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(54) **A transmitter for a remote control group.**

(57) A transmitter (2) for a remote control group can learn a code embedded in a radiation signal received from another transmitter (2) of the same group. A non-resettable teach status switch (16) sets an instruction which is transmitted with every time a code is transmitted. This instruction may be recognised by a receiving transmitter and instructs operation of the receiving transmitter. The information may be to indicate whether or not the code may be learned by the receiving transmitter and therefore, a transmitter may be set as a "learn only" transmitter or as a "learn and teach" transmitter. It is only necessary for the user to press the relevant transmit button on each of the transmitters. This is because the controller (20) of the transmitter monitors a radio receiver (23) every time the transmit button is pressed. In addition, it delays transmission of a code when a transmit button is pressed so that it can listen to the radiation receiver (23). There are two delay periods, the first for detection of a signal, and the second longer period for recognition of a valid code. The second period is not used if no signal is detected in the first period.

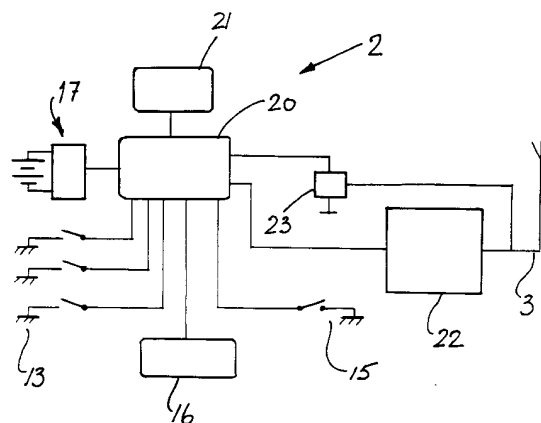


Fig. 3

The invention relates to a transmitter for a remote control group, the transmitter being of the type comprising:-

- a controller;
- a non-volatile memory;
- a radiation transmitter;
- a radiation receiver;
- a user interface;

a means in the controller for directing transmission of a radiation signal having an embedded code recognisable by a receiver of the group for activation of a shared function; and

means in the controller for directing reception of a radiation signal, for extraction of a code from a received signal, and for storage of the code in the non-volatile memory to learn the code for future use.

In this specification, the phrase "remote control group" is intended to cover a group wherein there are one or more receivers and a number of transmitters. The invention applies particularly, but not exclusively to gate and barrier opening remote control groups where there may be hundreds of transmitters and several receivers.

United States patent specification No. US-A-4988992 (Chamberlain) describes a transmitter having the features set out above. In this transmitter, a program switch and a transmit switch are pressed simultaneously to cause random generation of a code which is inputted to a NOR gate. The other input of the NOR gate may receive at the same time a code from another transmitter via a radio reception circuit. If a remote code is being received, the random code generator is disabled and it is the received code which is stored in the non-volatile memory. If no remote code is being received, it is the randomly generated code which is stored.

While this arrangement is apparently quite effective at providing for storage of fresh codes, it appears that problems would arise in security in the remote control group as the transmitter can learn a code from any other transmitter of the group. Thus, it would be quite easy for unauthorised people to operate a transmitter to learn a correct code from another transmitter.

Another problem is that it is necessary to press simultaneously a combination of two input buttons out of a total of three such buttons. This requires a certain degree of knowledge of the program state of the transmitter. Where the remote control group includes hundreds of users, it can be quite time-consuming to educate every user as to how the transmitter operates.

There is therefore a need for a transmitter which provides for additional security in control of remote control groups, and also for a transmitter which is easier to operate than heretofore.

Prior art documents of less relevance to the present invention than US-A-4988992 include US-A-

4652860 (BMW) and EP-A1-0533623 (Somfy). In US-A-4652860, there are several input buttons to be selected from by the user for learning of a code and thus, operation of the transmitter is relatively complex. Further, there do not appear to be any features controlling the extent to which transmitters of a remote control group may learn codes. Similar comments apply to EP-A-10533623, in which a galvanic link is used for learning of code.

The invention is characterised in that the controller further comprises:-

means for embedding an instruction together with the code in a transmitted radio signal to instruct operation of a transmitter receiving the signal; and

means for automatically monitoring received radiation signals for presence of such an instruction, and for operating according to the instruction.

Thus, in a very simple manner, the invention provides for control of operation of transmitters in a remote control group. This is very important, particularly where the group is large.

In one embodiment, the instruction is an indicator as to whether or not the accompanying code can be learned, thereby setting the transmitter as having a teach and learn status or a learn only status. Accordingly, the transmitter may be set as a learn only or as a teach and learn transmitter in a very simple manner.

In one embodiment, the controller is connected to a non-resettable switch which determines the instruction to be embedded in the radiation signal. This provides security in setting of transmitter operations.

Preferably, the radiation signal contains a sequence of binary bits, the instruction being within a pre-set sequence of the bits. This allows for simple and fast operation.

In a further embodiment the controller is activated to automatically monitor the radiation receiver in response to a transmit instruction from the user interface. This feature allows the transmitter operate to learn a code in a very simple manner without any technical knowledge in addition to that required for opening a barrier using the transmitter, for example.

In this latter embodiment, the controller comprises a means for delaying signal transmission for a pre-set period after receipt of a user transmit instruction, and a means for monitoring the radiation receiver during said period. This avoids interference and the need to use separate operating wavelengths. In effect, it achieves the advantages of simple operation without internal complexity of circuitry.

In another embodiment, the controller further comprises a means for delaying signal transmission for a second period if a signal is detected during the first period, and a means for attempting to extract a code embedded in a detected signal during the second period. This provides a significant degree of reliability of operation and reduces significantly the

chances of data corruption.

According to another aspect, the invention provides a transmitter for a remote control group, the transmitter comprising:-

- a controller;
- a non-volatile memory;
- a radiation transmitter;
- a radiation receiver;
- a user interface;

means in the controller for directing transmission of a radiation signal having an embedded code recognisable by a receiver of the group for activation of a shared function;

means in the controller for reception of a radiation signal, for extraction of a code from a received signal and for storage of the code in the non-volatile memory to learn the code for future use,

characterised in that,

the controller comprises means for automatically monitoring the radiation receiver in response to a transmit instruction from the user interface.

The invention will be more clearly understood from the following description of some embodiments thereof given by way of example only with reference to the accompanying drawings in which:-

Fig. 1 is a diagrammatic sketch showing a remote control group;

Fig. 2(a) is a plan view of a transmitter of the invention;

Fig. (2b) is a plan view showing the manner in which a code is learned;

Fig. 3 is a diagram illustrating construction of the transmitter in more detail; and

Fig. 4 is a flow chart illustrating operation of the transmitter.

A simple example of a remote control group is shown in Fig. 1, the group being indicated generally by the reference 1. The group 1 comprises a set of transmitters 2, each having a transmission antenna 3. The group 1 also includes a receiver 4 which picks up signals from the transmitters 2 at a receiver antenna 5. The receiver 4 is connected to an output device, not shown, which is typically a door such as a garage door. While only three transmitters 2 are shown there will typically be hundreds of transmitters for a single remote control group. Indeed, there may also be several receivers, each receiver being for control of a shared function such as the opening of a gate or barrier. The receiver 4 stores three valid codes, which are used as references for comparison with codes received from the transmitters 2 for activation of the three shared functions. Each function and its code is referred to as a channel.

Referring now to Fig. 2(a), the external appearance of a transmitter 2 is shown. The transmitter 2 comprises a moulded plastics casing 10 having a removable cover 11 with a resilient catch 12. The transmitter 2 has three channel select buttons 13. Each

button 13 is associated with a particular code stored within the transmitter 2, there being three channels in the receiver 4. For example, one function may be opening of a barrier, another closing of a barrier, and another may relate to a different speed for opening or closing. Alternatively, the functions may be for different barriers allowing access to a site. A light emitting diode (LED) 14 is mounted on the outside of the casing 10. The compartment which is covered by the cover 11 includes a randomise button 15 which is pressed if the user wishes to randomly generate a new code for storage in the non-volatile memory. There is also a teach status switch 16 which is in the form of a conductor, the status being the conductor intact as shown in Fig. 2a, or being open-circuited by being cut. This function is described in more detail below. The compartment also includes a battery 17 connected to terminals 18.

Referring now to Fig. 3, the transmitter 2 is illustrated in more detail and parts similar to those described with reference to the previous drawings are identified by the same reference numerals. The transmitter 2 includes a micro-controller 20 which is programmed by programs stored on-chip and in an EEPROM non-volatile memory circuit 21. The transmitter 2 includes a radio transmitter 22 and a radio receiver 23, both of which are connected to the antenna 3.

Reference is now made to Figs. 2(b) and 4 to describe operation of the transmitter 2. When the transmitter 2 is being used for activation of a shared function such as opening of a gate, the user simply presses the channel select button 13 which relates to the particular function. The microcontroller 20 detects depression of the relevant button 13 and activates the LED 14 to indicate that the transmitter 2 is operational and at the same time activates the radio transmitter 22 to transmit the channel code retrieved from the memory 21. The code is transmitted using the Frequency Shift Keying Coding System. The codes which are stored in the memory 21 may be generated initially by pressing the randomise button 15 which instructs the microcontroller 20 to randomly generate a new code. However, it should only be necessary to perform this operation once.

A much more common way of recording a code in the memory 21 is to learn the code from another transmitter 2 as shown in Fig. 2(b). For clarity, the words "teaching" and "learning" will be used to indicate which transmitter is being referred to in the description below. The two transmitters are placed next to each other and the relevant channel select button 13 is pressed on both transmitters that of the teaching transmitter being pressed firstly. This is all that is required of the user and the LED 14 of the learning transmitter flashes to indicate that the code has been successfully learned. There is no need to press any other button - just the button which is normally press-

ed for the particular channel. It will be appreciated that to the user this is a very important feature of the invention. Heretofore, the assumption of users and installers has always been that teaching of a code is a specialist task requiring a degree of technical knowledge. The invention allows this task to be done as simply as opening a barrier with the transmitter. The technical features to achieve this are described below.

Another important feature is that the teaching transmitter 2 may only be used for teaching of a code if the controller 20 has been pre-set to allow it to teach code. This provides considerable additional security and allows control over the manner in which the transmitters are configured when being given to users of a remote control group.

These features are achieved as described below. Firstly, the teach status switch 16 is pre-set. If the switch 16 is conductive, then the microcontroller 20 "knows" that it can act as a code teaching transmitter. Therefore, every time a transmit button 13 is pressed it transmits the code via the radio antenna 3 but includes in addition to the code, an instruction, namely, an additional bit at bit position 25 to indicate that the code may be learned by another transmitter. The code is 24 binary bits long, and the extra bit 25 indicates whether or not the code may be learned. If, however, the switch 16 were cut to provide an open circuit to the microcontroller 20, then the microcontroller 20 would "know" that it can not teach and the value of bit 25 will be understood by other transmitters as an indication that the code can not be learned. Thus, as shown in Fig. 2(b), the upper transmitter 2 has an intact teach switch 16 and therefore the 25th bit in the code which is transmitted has binary value 1 which is understood by the lower transmitter 2 to mean that the code can be learned. The switch 16 may be regarded as being non-resettable as it requires special knowledge of the circuit and soldering equipment to change.

It will be appreciated that instead of using a status switch such as the switch 16, a teach status indicator may be stored in the memory 21 to indicate to the controller 20 whether or not it can operate as a teaching transmitter.

The ability to learn a code by only pressing the relevant transmit button on each transmitter is achieved as illustrated in Fig. 4. This drawing is a flow chart illustrating how the controller 20 of a learning transmitter 2 operates. The user presses the relevant transmit button 13 on the teaching transmitter 2, and immediately afterwards in step 31 on the learning transmitter 2. In step 32 the controller 20 of the learning transmitter 2 spends 12.5 ms listening for a signal at the radio receiver 23. If no signal is detected in this 12.5 ms time period as indicated by decision steps 33, the learning transmitter 2 in step 38 simply transmits the code associated with the transmit button 13 which

has been pressed. However, if a signal at the relevant frequency (even if the signal can not be understood) is received during this 12.5 ms time period, in step 34 the controller 20 of the learning transmitter 2 spends a further 3 seconds listening for and extracting a code within the signal being received as indicated by step 34. As indicated by the decision steps 35 and 37, the controller continues to listen during the three second time period and if this period expires without a valid code being extracted, the relevant code associated with the transmit button 13 which has been pressed is transmitted in step 38. If, however, a valid code is identified during the 3-second time period, this code is stored in step 36 in the non-volatile memory 21. Subsequently, the code is transmitted in code 38. In step 39 the transmit button is released and the learning operation is complete.

It will thus be appreciated that simplicity of the learning operation is achieved by the fact that the controller listens for a code being received on depression of only a transmit button. Thus, it operates to listen for a code every time the transmit button is pressed. This considerably simplifies operation of the transmitter. Data integrity and reliability are received in particular by delaying transmission of a code while the controller listens to the radio receiver for reception of a radio signal. The delay time for the vast majority of cases is only 12.5 ms because no relevant signal will be detected. However, when a new code is being taught to the transmitter, a signal will be detected during the first period and the second period will then be used for extraction of the code and storage of it in the memory 21. If a signal is detected during the first 12.5 ms period, but no valid code is detected during the second 3s period then no code is stored. Invalidity of the received code would include the 25th bit having a value 0 to indicate that the code can not be learned i.e. the "teaching" transmitter is not a valid or authorised teaching transmitter.

It will be appreciated that for the remote control group 1, a transmitter may be initially programmed by pressing the randomise button 15 and this transmitter may then be used for teaching each of the other transmitters of the group, and also the receiver. Thus, coding of all devices of the remote control group is extremely simple and quick. Complete versatility is then provided by the ability to set each successive transmitter as being a "learn only" transmitter or alternatively as a "learn and teach" transmitter depending on the instruction transmitted together with the code. This considerably improves the control over operation of the remote control group. Users may very easily teach code to a new transmitter by simply pressing the transmit button only and monitoring the LED 14 for a flash.

The invention is not limited to the embodiments hereinbefore described. For example, the transmitter may include separate antennae for the radiation

transmitter and receiver. Further, the transmitter may use any other remote communication medium such as infra red or radiation of any suitable frequency. The features of the invention apply equally to all types of radiation, and in the embodiment illustrated radio signals are used as circuits for radio communication are particularly inexpensive and reliable.

The delay times for listening at the radiation receiver may be varied considerably from those described. Possibly the minimum listening time for listening for a signal would be about 5 ms, however, the upper limit could extend to 0.5s or even higher. Indeed, it is not essential that the controller delay transmission of a code while it listens to the radiation receiver as different radio wavelengths may be used and both could happen simultaneously. However, it will be appreciated that by delaying the transmission of a signal a relatively simple and inexpensive circuit may be used and there is improved reliability.

An important feature of the invention is the manner in which the code which is transmitted includes an extra bit to indicate to the receiving transmitter whether or not the code may be learned. The instruction which is provided every time a signal is transmitted is of major importance in providing control for the remote control group. However, it will be appreciated that the instruction which is transmitter together with the code may be of a different type to instruct operation of the receiving transmitter. It may include information, for example, to the effect that a code may be learned only for the particular channel on the receiving transmitter.

Claims

1. A transmitter (2) for a remote control group, the transmitter (2) comprising:
 - a controller (20);
 - a non-volatile memory (21);
 - a radiation transmitter (22);
 - a radiation receiver (23);
 - a user interface (13);
 - means in the controller (20) for directing transmission of a radiation signal having an embedded code recognisable by a receiver of the group for activation of a shared function; and
 - means in the controller (20) for directing reception of a radiation signal, for extraction of a code from a received signal, and for storage of the code in the non-volatile memory (21) to learn the code for future use,
 - characterised in that,
 - the controller further comprises:-
 - means for embedding an instruction together with the code in a transmitted radio signal to instruct operation of a transmitter (2) receiving the signal; and

means for automatically monitoring received radiation signals for presence of such an instruction, and for operating according to the instruction.

2. A transmitter as claimed in claim 1 wherein the instruction is an indicator as to whether or not the accompanying code can be learned, thereby setting the transmitter as having a teach and learn status or a learn only status.
3. A transmitter as claimed in claims 1 or 2 wherein the controller (20) is connected to a non-resettable switch (16) which determines the instruction to be embedded in the radiation signal.
4. A transmitter as claimed in any preceding claim, wherein the radiation signal contains a sequence of binary bits, the instruction being within a pre-set sequence of the bits.
5. A transmitter as claimed in any preceding claim, wherein the controller is activated to automatically monitor the radiation receiver in response to a transmit instruction from the user interface.
6. A transmitter as claimed in claim 5 wherein the controller comprises a means for delaying signal transmission for a pre-set period after receipt of a user transmit instruction, and a means for monitoring the radiation receiver during said period.
7. A transmitter as claimed in claim 6, wherein the controller (20) further comprises a means for delaying signal transmission for a second period if a signal is detected during the first period, and a means for attempting to extract a code embedded in a detected signal during the second period.
8. A transmitter (2) for a remote control group, the transmitter comprising:-
 - a controller (20);
 - a non-volatile memory (21);
 - a radiation transmitter (22);
 - a radiation receiver (23);
 - a user interface (13);
 - means in the controller (20) for directing transmission of a radiation signal having an embedded code recognisable by a receiver of the group for activation of a shared function;
 - means in the controller (20) for reception of a radiation signal, for extraction of a code from a received signal and for storage of the code in the non-volatile memory (21) to learn the code for future use,
 - characterised in that,
 - the controller comprises means for automatically monitoring the radiation receiver in re-

sponse to a transmit instruction from the user interface.

9. A transmitter as claimed in claim 8, wherein the controller comprises means for delaying signal transmission for a pre-set period after receipt of a user transmit instruction, and means for monitoring the radiation receiver during the period. 5
10. A transmitter as claimed in claim 9, wherein the controller further comprises means for delaying signal transmission for a second period if a signal is detected during the first period, and means for attempting to extract a code during the second period. 10 15

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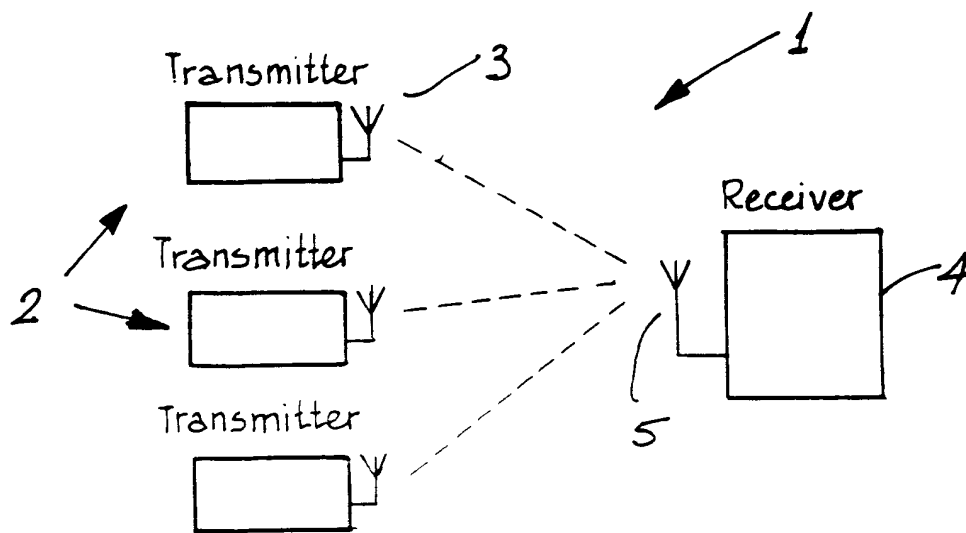


Fig.1

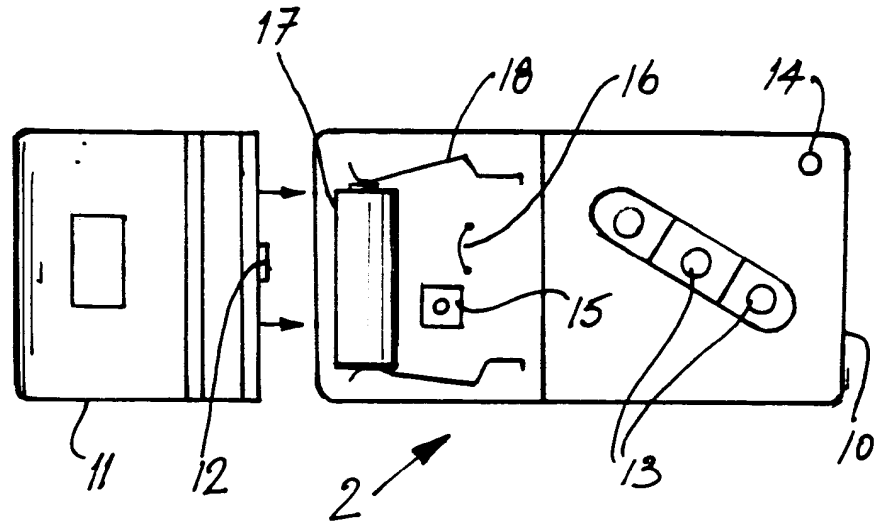


Fig. 2(a)

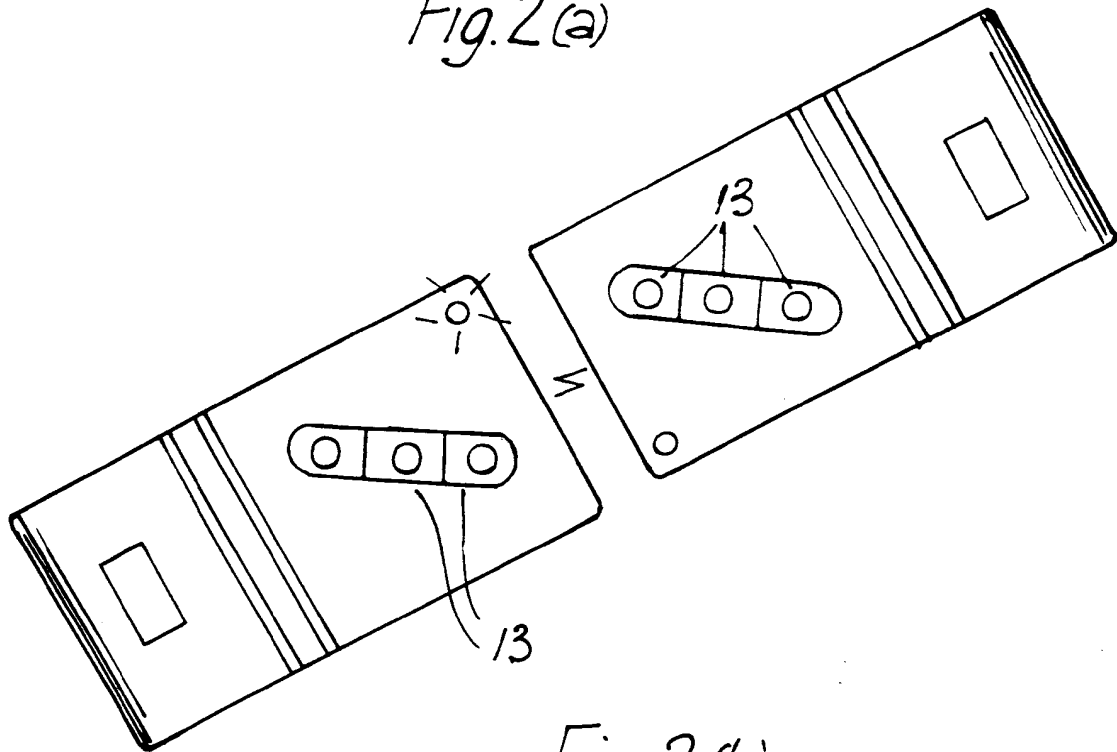


Fig. 2(b)

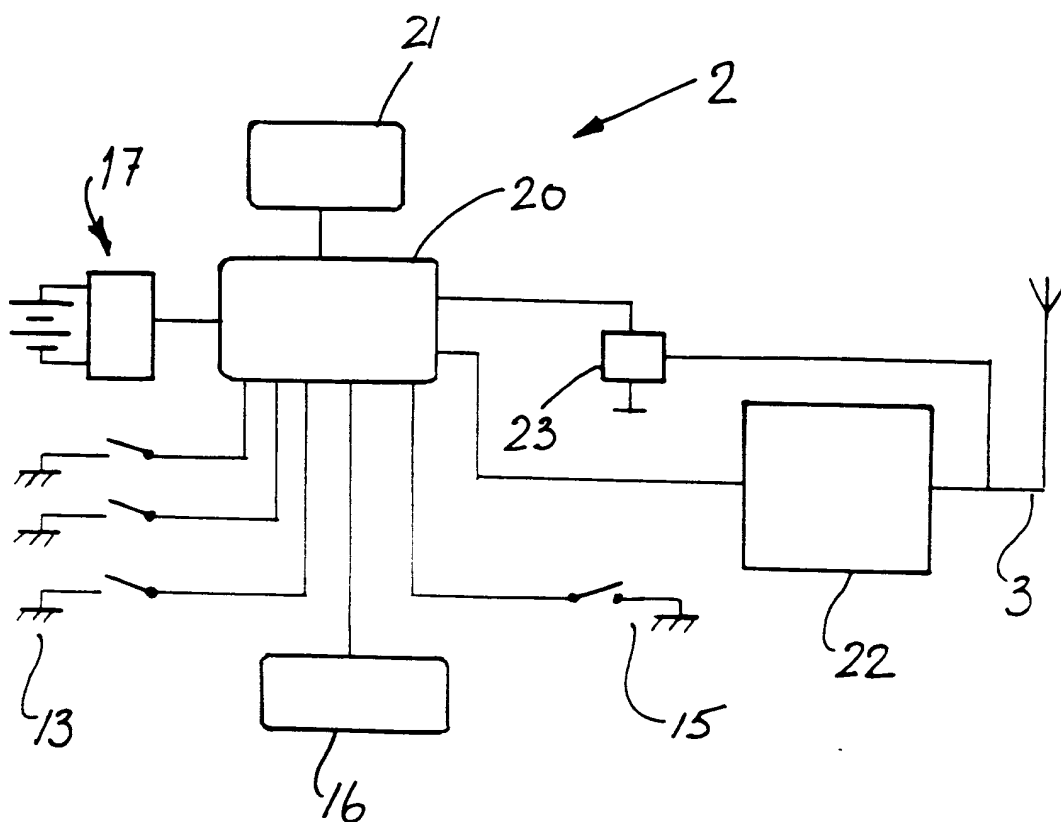


Fig. 3

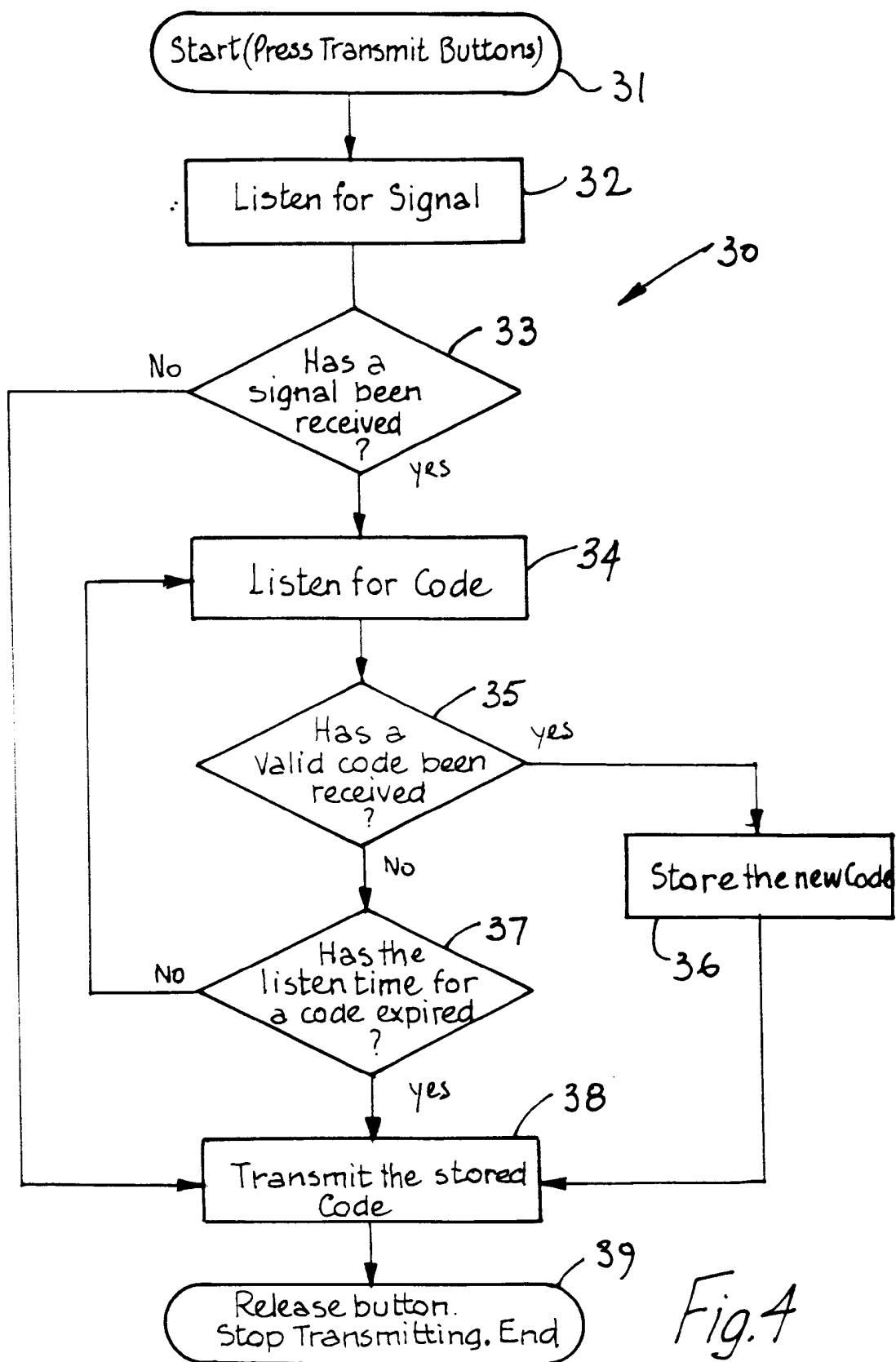


Fig. 4



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 65 0001

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	US-A-4 529 980 (LIOTINE,TWARDOWSKI) * column 2, line 44 - column 5, line 34; figures 1-6 *	1	E05B49/00 G08C19/28
A	---	4,5,8	
Y	EP-A-0 268 902 (NEIMAN) * column 1, line 47 - column 2, line 23 *	1	
A	---	2,4,5,8	
A	US-A-5 148 159 (CLARK,MARTEL,MURRAY) * column 5, line 15 - column 20, line 13; figures 1-11 *	1,4,5,8	
A	US-A-5 237 319 (HIDAKA,MIYASHITA)		
A	US-A-4 623 887 (WELLES)		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6) E05B G08C
Place of search		Date of completion of the search	Examiner
THE HAGUE		7 December 1994	HERBELET, J
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